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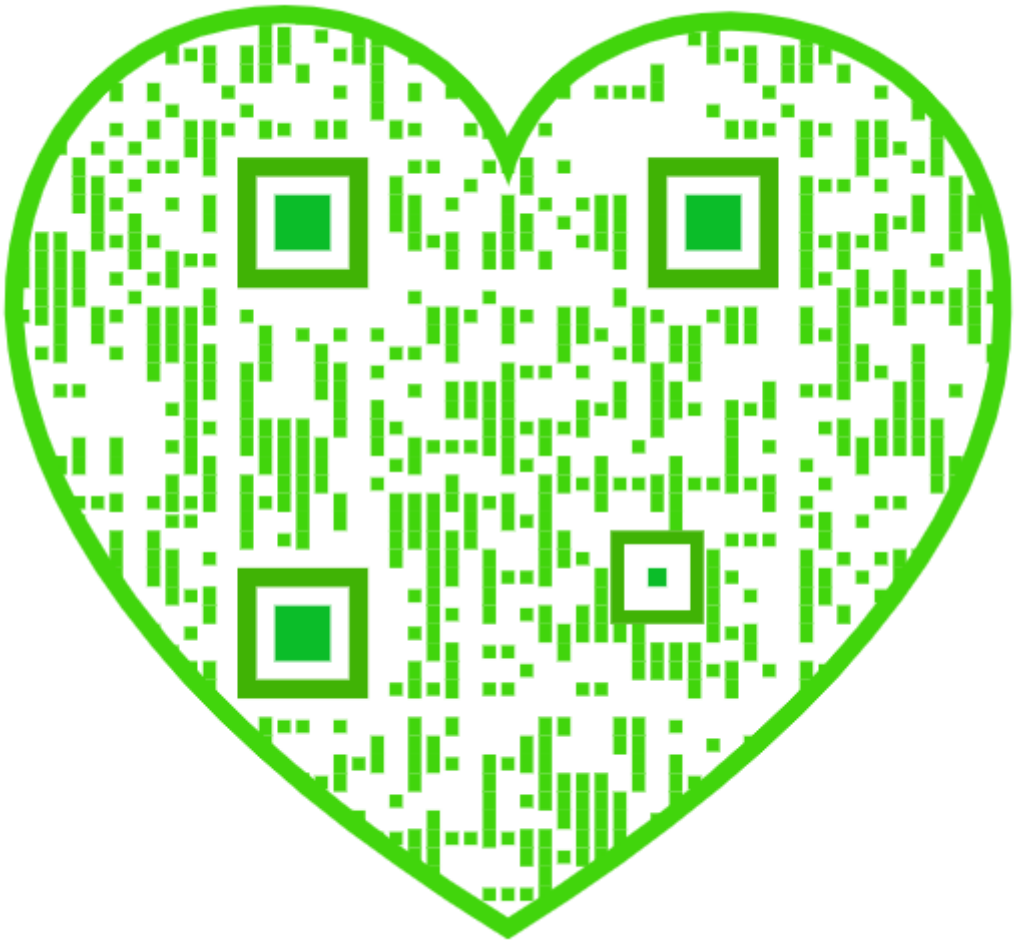

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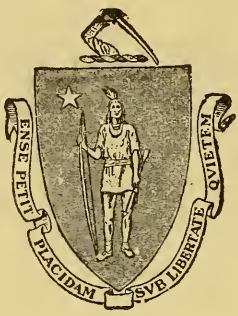

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Contents

Artificial Fertilizers

Experiments with Fertilizers

Essais de culture avec les Engrais Chimiques.

Experimentos con fertilizantes

Fertilizing Orchard and Garden

Fertilizing Tobacco.

Fertilización del tobaco

Orange Culture

Potash Pays

Results

Strawberry Culture

Sugar Beet Culture.

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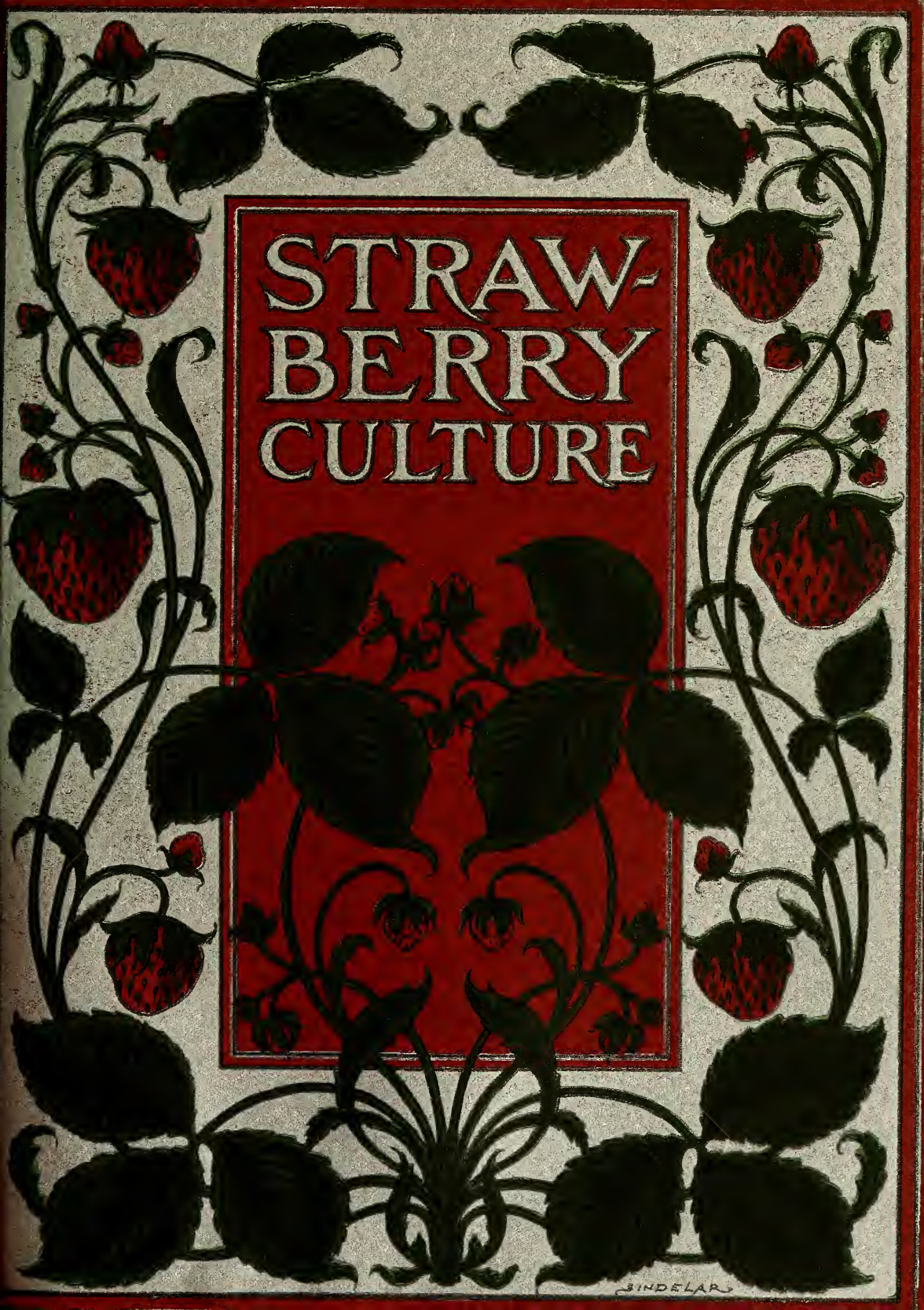
STRAW-
BERRY
CULTURE
BINDELAR

STRAWBERRY HAND-BOOK.

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STRAWBERRY HAND-BOOK.

THE growing of strawberries has become quite an important industry in almost every section of the United States. The reasons for this are plain. The strawberry is a plant that can be made to grow profitably on almost any soil; it is sure of a ready market, which, on account of a growing demand, continually enlarges so that there is no serious danger of overproduction, and it is a money crop coming very early in the season, when a little money "comes in handy" before money is received from the other crops. It is not difficult to grow strawberries, but it takes knowledge and experience to get a steady and fair profit. Every place has its peculiar local conditions of climate and weather. It is impossible to make rules to fit all these conditions, but a careful reading and consideration of the following pages may help the grower or farmer to adapt measures to his own conditions. One thing should always be kept in mind: *Take pains.* If you do that you will make a success of strawberry culture.

Selecting the Soil. The strawberry plant can be grown on most soils. Perhaps the best land naturally is a dark sandy loam. Any soil which will produce a good corn crop will make good strawberry land. A rather light soil, loamy, is certainly preferable, but natural conditions may be greatly modified in the desired direction. An open, well drained soil, of even texture and kept free of weeds, is just the thing. To a very considerable extent, even heavy

clay soils may be brought into this condition by the use of lime and sub-soiling. The plant needs an ample supply of moisture, but cannot develop if its roots are in a cold, sodden soil. Avoid very low-lying plots, as there is in such conditions considerable danger from frost. A slope to the south will make the fruit earlier; a slope to the north or northeast will encourage late ripening.

Preparation of the Soil. The soil should have been in some cultivated crop the year previous to a planting of strawberries, as this gives not only a soil in good tilth, but also guards against a too free growth of weeds and checks various insect attacks. Red clover sod or land that has laid fallow, is apt to be infected with white grub and other insect enemies. A clover sod may contain large stores of plant food in the form of organic matter, but it will decompose so slowly that the plants will be kept back until late in the season, when a too free growth is not desirable. If the clover sod or fallow land is plowed in the spring and planted to a cultivated crop, it will be in excellent condition for strawberry planting the following fall, winter, or spring.

Plow thoroughly, even cross-plow if the soil is heavy. If cloddy, reduce to a fine condition by thorough harrowing. It will most always pay to subsoil, especially in sections given to droughts, as the capacity of the land to retain moisture is thereby increased. Clay lands should always be subsoiled.

On hilly land, the beds may be ridged across the slope; if the soil is light, some such protection against washing is necessary. Terracing will pay where it is needed, especially

if pains are taken to maintain the terraces every time the land is broken.

Selecting Varieties. It is not always safe to pick out a variety of strawberry from the accounts given in plant catalogues. A perfect all-around berry is about as hard to find as a perfect all-around milk cow. Usually it is best to take the advice of a neighbor who knows about the different varieties, or if you cannot get this, you can write and get the opinion of the editor of a farm journal. Varieties change much as fashions change. There is not much foundation for the claim that certain varieties are suitable for light soils, or heavy soils, etc. Large crops of fine berries are only grown on soils very rich naturally, or made so artificially.

Blossom of a Staminate, or perfect, strawberry plant.

There are two distinct classes of strawberry plants, known as the perfect and imperfect varieties; also known as *staminate* and *pistillate*. The perfect or staminate plants are bi-sexual, which means that they produce fruit as a natural condition; the pistillate varieties are one-sexed, and will not produce fruit unless planted in proximity to staminate varieties. The safest plan is to plant one row of staminate plants to every two rows of pistillate.

Blossom of a Pistillate, or imperfect, strawberry plant.

There is some dispute as to the relative merits of the two classes, but it is generally admitted that the pistillate varieties are the hardier and most suitable as a market berry. When planting the two classes together, it must be remembered to have the two varieties ripen at the same time, and if possible, of the same general color and shape. Unless they blossom practically together, the influence of the staminate variety may be wholly lost.

When to Plant. Plants may be set at any time in the year, except winter in the north, or when the weather is very hot, or the soil very dry. As hot and dry times are likely to occur in summer, it is best not to plant at that time unless potted plants are to be used, or the plants may be moved with a considerable ball of earth adhering to them, which is rarely practicable on a large scale.

The safest time to set is when the sun is weak, for then the soil is apt to be moist and cool—say from September 15th to April 15th. Another rule is never to transplant after blooming has commenced; and yet, very successful settings are made with blooming plants, the bloom being pinched off. In the far South, nearly all planting is done in September, October and November, and a full crop of berries harvested the following spring.

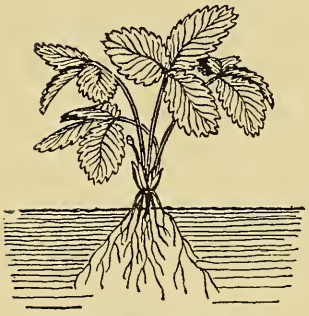
In the north comparatively little planting is done in the fall, yet it may be safely done at any time up to freezing weather. Plants set in the north in the fall should always be mulched, as described later on. This is to prevent the "heaving" of the soil during hard freezes, and the conse-

quent "lifting" of the plants. Early spring, as soon as the soil can be prepared, is the favorite time for planting in the north. This is also the best time for stiff soils, such soils being most given to heaving out in the middle states.

South of the latitude of Washington, D. C., late fall and winter planting is the best on very stiff soils likely to be wet, on account of the danger of heaving out by freezes. If the soil is at all light, every good day in the late fall and winter can be used in preparing the land, and in planting. The strawberry plant is at that time very easily set without loss, and it is also out of the way of the spring work. However, planting may be done at any time, and even a little after the plants begin to bloom, though the earlier it is done the surer the stand.

How to Plant. Run off the rows three feet apart. If the area is limited, two and one-half feet will do if the plants are to be grown in hills or stands. If matted rows are to be grown, three to three and one-half feet will be required. After the fertilizer has been applied in the furrow, and mixed with the soil by running a cultivator or light plow through it, list on this with one light furrow from each side. Knock this list or light bed down with hoes or a light horse drag. On wet lands, especially in the far south, it is found necessary to have the beds much higher. Strawberries planted on low beds do much better where there is likely to be a drought, or even ordinarily dry weather, during the growing or ripening season

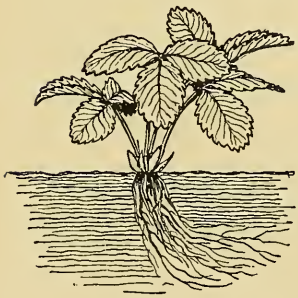
After the lists or beds are knocked down, open broad deep holes for the plants. Trowels or dibbles, though good to open holes, are too tedious for a large planting. Poles or stakes with the large end trimmed wedge-shaped and shod with iron two or three inches wide, do as well as trowels and are much faster with less tedious work. Stakes without the iron will last well if the land is not too heavy.



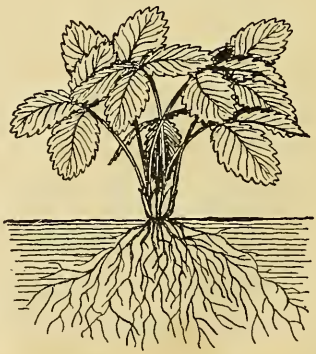
Plant set too high.

If the plant roots are very long, trim them back to about four inches; wet the roots well and drop at once, planting as fast as dropped. The plants should be set just deep enough to cover the roots and no deeper. The roots should be spread as near a fan shaped as possible in the broad holes, and the earth pressed firmly about them.

Plant set too deep.



Plant carelessly set with roots bunched.



Correct setting of plant both with regard to depth and arrangement of roots.

The distance apart in the row must be governed by whether the aim is to follow the stool or hill system, or the matted row. Plants to be grown in stools should be set 15 inches apart,

and if the soil is not rich even 18 inches apart; if matted rows are to be grown, the plants should be two feet apart in the row.

Stool Plants and Matted Rows. Stool plants is the usual name for planting in hills. By this method the soil may be worked both ways with horse hoes, and thus save greatly in the amount of labor by hand. About 12,750 plants are required per acre, and all the runners are clipped as fast as they appear. After the first bearing year some runners are allowed to set plants, for transplanting or fruiting the following year. The object is to save hand labor, and to maintain a clean cultivation.

Strawberries planted by the hill, or stool, system.

Matted rows refers to setting the plants in wide rows, and permitting runners to set between the plants in the

row, and also to spread out between the rows. For matted rows only about 7,500 plants are required per acre. Matted rows cannot be cultivated with horse hoes as completely as can the hill set plants, but a much larger number of plants may be massed on an acre. If the soil is very fertile, or kept in such condition that large quantities of fertilizer may be used, matted rows will produce more berries than the stool system; but, it must be remembered that 100 plants require just twice the water and food necessary for a good development of 50 plants. By the matted row system the plants sometimes increase so rapidly that the entire space is taken by the plants, and frequently they are kept cut back to occupy half the space. The wisdom of the wide rows depends on the strength of your soil, and your liberality in feeding it.

Strawberries planted by the matted row system.

Stool plants stand drouth better and bear more marketable berries to the acre than matted rows, because a more thorough tillage is possible. The stool system requires about 60 per cent more plants to the acre than the matted row system. In matted rows the young plants are apt to set too thickly, and weeds grow up among the plants causing much tedious hand work. Stool plants can be easily kept clean with horse cultivators, helped out with hoes.

The stool system cannot be followed to advantage unless the runners are cut as fast as they grow. Use knives and cut close to the plant. If allowed to grow and remain long on the parent plant, the runners weaken it greatly and the best results will not be possible. Otherwise, it is safer to plant for and follow the matted row system; in which case the runners are allowed to grow and take root, though not allowed to set too thickly. If the rows become too thickly set they should be thinned out in the fall to five or six inches apart, a task hardly practicable on a large scale.

Proper Cultivation. Frequent cultivation is best and cheapest in the end. After every packing rain, the soil must be stirred to a depth of from one to two inches—(very shallow near the plants.) This will not only keep back the weeds but also prevents the loss of water from surface evaporation. It will not do to wait for a rain if a drouth threatens. The plants should be cultivated every week, otherwise the moisture supply will be lacking.

Plow the middles to within six inches of the plants with a light small toothed cultivator, and stir around the plants with hand hoes. This method of cultivation must be kept up as late in the fall as the weeds and grass continue to come. Whether the matted row or the stool system is followed, clean culture is indispensable to success. It is not only a matter of destroying weeds, but also of keeping up the proper supply of moisture.

MANURING.

Correct fertilizing is far more important than the selection of the soil, for almost any soil will make fine berries if properly manured. No soil can make them for any length of time without judicious and liberal manuring. Some of the reasons why it pays to fertilize strawberries are:

(1) it vastly increases the yield, (2) gives larger berries, (3) a better color and flavor, and (4) firmer fruit. The last named quality—firmness—enables berries to be shipped long distances to a market and arrive fresh.

Several of the best known varieties were at first considered almost worthless, owing to a lack of firmness to carry them to the market, and freshness to sell them after they got there. The remedy for all this has been found in the liberal use of the mineral fertilizers. A strawberry crop on one acre needs for its development during three years on an average, 223 pounds of nitrogen, 375 pounds of potash, and 83 pounds of phosphoric acid. If liberal

crops are expected, the soil must supply the proper amounts of plant food. The objection to farmyard manure is that it contains too much nitrogen as compared with the potash and phosphoric acid.

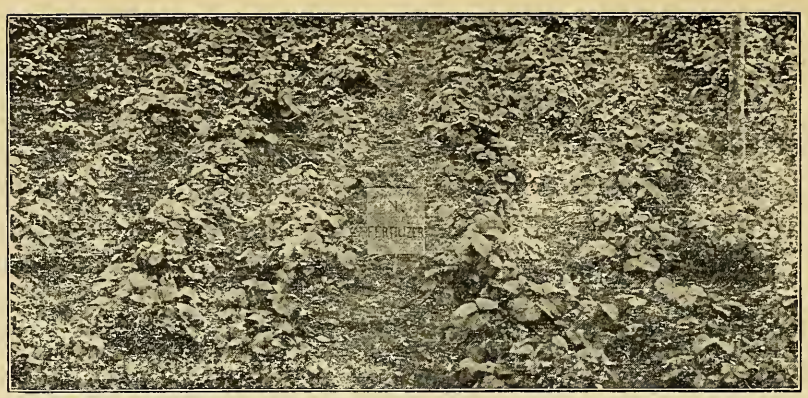
A strawberry fertilizer should contain the three principal plant food ingredients in about the following proportions:

Ammonia, - - - - - -	3 per cent.
Potash, - - - - - - -	9 per cent.
Phosphoric Acid, - - -	7 per cent.

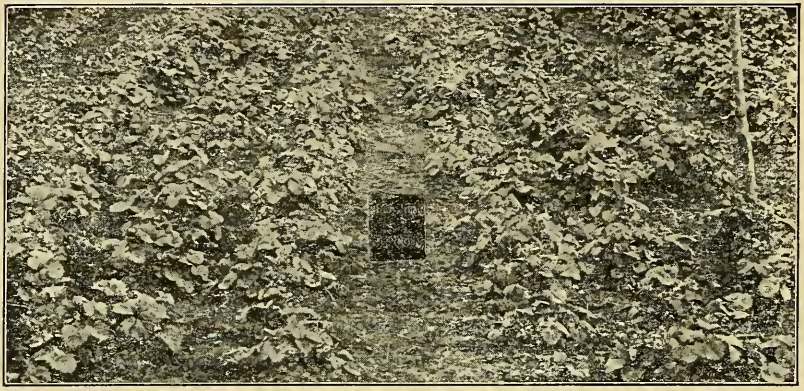
That is, every 100 pounds of fertilizer should contain 3 pounds of ammonia, 9 pounds of potash, and 7 pounds of available phosphoric acid. The phosphoric acid is placed far above the actual needs of the plant as shown by the analysis, because this fertilizer is likely to take insoluble forms in the soil; the ammonia is placed low as top dressings are made in the spring.

Often, and especially on sandy soils, it pays to use potash in larger proportions than the above formula calls for.

A fertilizer containing 3, 9 and 7 per cent respectively of ammonia, potash and phosphoric acid will be a good strawberry manure. You can make this mixture yourself, or have the dealer make it for you. It should be applied at the rate of 500 pounds per acre drilled in before planting, and thoroughly mixed with the soil by running a cultivator or light plow along the furrow before the land is listed, or bedded. In the spring, an application of 150 pounds of nitrate of soda should be broadcasted per acre,



Without Fertilizer.



With Phosphoric Acid and Nitrogen.

With Potash, Phosphoric Acid and Nitrogen.

Illustrations showing effect of fertilizers on strawberry plants. Experiment by Prof. E. Lierke, Germany.

as soon as the first signs of growth appear. For fruiting beds, the full application of 500 pounds per acre is made broadcast in the summer or fall, and worked in with a cultivator if the ground is not frozen.

A great deal of such fertilizer can be profitably used on the strawberry if applied at proper intervals, as follows: In the spring before planting, again late in the summer or early fall *around* the plants, and again in the winter or very early spring directly over them—in all from 900 to 1500 pounds may be used with profit. This mode of fertilizing will nearly always be found more profitable than applying all the fertilizer in one annual application.

One point must always be remembered, and that is, never sow fertilizers directly on the plants in warm weather while they are in the green growing state, and never sow it on them even in winter unless the leaves are dry. In the far south where the plants keep green all winter, the fertilizer must be distributed around the plants, preferably just before rain.

If a suitable commercial fertilizer is not obtainable, the mixture may be made on the farm from fertilizer chemicals. The following materials are most suitable:

For Ammonia:

Nitrate of Soda, containing 18 lbs. of Ammonia per 100 (18%).
or Sulphate of Ammonia, " 23 " " " " 100 (23%).

For Potash:

Sulphate of Potash, containing 51 lbs. of Potash per 100 (51%).
or Muriate of Potash, " 50 " " " " 100 (50%).
or Kainit, " 12 " " " " 100 (12%).

Phosphoric Acid:

Acid-Phosphate, containing 14 lbs. of Phosphoric Acid per 100 (14%)
Dissolved Bone, " 16 " " " " " " (16%)

Cotton-seed meal may also be used; it contains 8 pounds of ammonia and about 2 pounds of available phosphoric acid per 100 pounds.

For an application which will be the same as 500 pounds of the formula given as best suited for the strawberry, make the following mixture:

For Ammonia:	100 lbs. Nitrate of Soda, or
	75 lbs. Sulphate of Ammonia, or
	200 lbs. Cotton-Seed Meal.
For the Potash:	90 lbs. Sulphate of Potash, or
	95 lbs. Muriate of Potash, or
	400 lbs. Kainit.
Phosphoric Acid:	250 lbs. Acid Phosphate, or
	225 lbs. Dissolved Bone.

Liming the soil at the rate of 40 bushels of agricultural lime per acre, just before planting, will generally be an advantage, especially if the soil is inclined to be clayey, but if sulphate of ammonia is used liming is a necessity. For the spring top-dressing, nitrate of soda is used only, and this application is to be in addition to the 500 pounds per acre.

In preparing all fertilizers, a thorough mixture is very necessary for good results. None of the above ingredients are injured by exposure to the sun; they can be sown over or around the plants and left for the rain to wash in, without loss of strength.

The Crop-Making Power of Fertilizers. It has been found that the crop-making power of a manure or fertilizer is no greater than its weakest ingredient. This means that if a manure or fertilizer contains only a small amount of one of the three fertilizing ingredients, it will not produce good results or yields.

As has been stated, one acre in strawberries during a three years' growth, uses up 223 pounds of nitrogen, 83 pounds of phosphoric acid, and 375 pounds of potash. Therefore, plants to do well *must* have these quantities. To take these different elements from the soil without putting them back sooner or later exhausts the soil.

Again, farmyard manure made chiefly from grain and hay is not well balanced in fertilizing ingredients for fruit. For example, seven tons of farmyard manure of good quality will give the following amounts of fertilizer:

In an Acre Strawberries.	In 7 Tons Manure.
Nitrogen, - - 223 lbs.	77 lbs.
Phosphoric Acid, 83 lbs.	57 lbs.
Potash, - - - 375 lbs.	74 lbs.

Thus, fully thirty-five tons of farmyard manure would be needed to furnish the required amount of potash for an acre of strawberries, and even then if the season is favorable the excess of nitrogen produces rank growth of foliage at the expense of the fruit.

As we have pointed out, by the matted row system only about two-thirds as many plants are set per acre as by the hill or stool system, but the runners are allowed to grow so

that the actual number of plants fruiting is greater. While less fertilizer may be applied to the matted row system the first year, the difference must be fully made up the following year. A strawberry bed soon runs out, in fact it is often claimed that one good fruiting year is all that may be profitably worked. If the plants are properly fertilized the beds should last three years, but they must be manured each year, and quite as much attention paid to tillage as during the first year of growth. To have fine, large berries and plenty of them, large healthy plants are necessary and these are obtained only by thorough fertilization and careful tillage and runner pruning.

Use of Mulch. The object of mulching is to keep the fruit clean, and the soil cool and moist. It aids liberal potash manuring in securing that clean, clear color and gloss, which attract customers in the markets. Gritty berries dull in appearance and otherwise undesirable bring the poorest prices.

Any material which lies close and is heavy enough to stay on the plants will answer the purpose of mulching. Pine needles are widely used in the south; wheat and oats straw, or salt-marsh hay are also excellent, but should be weighted with a little earth. Care must be taken not to use old hay full of weed seeds.

The mulch should be scattered evenly very close around the plants, and over the whole width of the rows if practicable. It should be applied very early, but not before the plants begin to grow unless it is desired to

retard fruiting a few days. Care must be taken not to let the mulch lie so thick at any point as to smother the plants. Shake the material loose and scatter it just thick enough to hide the ground. The mulch should be removed from over the plants if they do not come through readily. When a mulch is applied after the growth has well started, it is best to apply it closely around and between the plants by hand.

Winter Protection. Winter protection is necessary where the temperature falls to zero, and is needed even in warmer latitudes, especially in stiff soils. This protection is precisely the same as the mulch, except that it is more thickly applied. The mulch should be at least two inches thick, while three will be better in very cold sections, or where there is much thawing and severe freezing in the late winter. In the spring, the rows must be opened to permit the plants to get through easily. Both for mulching and for winter protection, the work must be done thoroughly.

Immediately after fruiting, remove the mulch and commence the regular cultivation of the plants. While a mulch will conserve moisture in the early days of the summer, later on the sun will destroy its usefulnes, and tillage must be used. Winter protection should not be supplied before the ground begins to freeze hard.

Picking and Shipping. Women and girls make the best berry pickers. Let each picker have a series or number of rows for the whole season. Then the pickers

will come to take an interest in the rows assigned to them and will be apt to show care and thoroughness. The grower should provide each picker with a light picking tray in which the quart baskets can be placed as fast as filled. It is well to have a covering for the tray to keep off the sun and rain.

If there is no house near the field, a rough shed should be erected to shade the berries when they are picked. A good method of keeping count of the picking is to issue to the pickers basket checks. Let each picker have so many checks, and then give up a check for every basket of fruit brought to the store shed, where the account can be checked by the field boss. The price which the grower gets, depends in a large measure on the berries being picked at just the right stage of ripeness, and in their being carefully handled and packed. Berries should be picked by the stem, which should be pinched off about one inch long. The berries should never be taken in the hand.

Grade the fruit honestly all through, but dress off the baskets neatly, slightly heaped in the middle of the basket, turning the reddest side of the berry up. Always pack the berries as ripe as you find they will carry to market well. Refrigerator cars make it possible to pick berries much riper than some years back when only ordinary cars were used. Use only new fresh crates and baskets, which can be bought cheap in large quantities. Consult your commission merchant as to the size of the crates to be used; different markets require different sized crates.

Always pick the berries as cool as possible, and it is an advantage to have them picked dry. Do not wait, however, for the sun to dry off the dew if the weather promises to be at all warm, for the sun in drying off the dew will heat the berries. When refrigerator cars are used, heat is not to be feared, for the fruit gets chilled in a few minutes after being placed in the cars.

Garden Culture. As space in the garden is usually limited and cultivation is usually done with a hand hoe or hand cultivator, strawberry plants may be safely set much closer than in field culture. A good plan is to have the rows one foot apart, and to set the plants one foot apart in the row. Between every three rows of plants have an alley or walkway two feet wide, which gives access to the bed for cultivating and picking the fruit.

If the soil is not very rich it will be better to set the plants 15, or in extreme cases 18, inches apart. The same fertilizers recommended for field culture may be used, but the quantity may be greatly increased as it is practicable to mix the ingredients quite thoroughly with the soil. Five hundred plants occupying a bed 20x40 feet if set 12 inches each way, will if well manured and kept free of weeds, fairly supply a medium sized family. By setting early, medium and late varieties, the season can be prolonged for about six weeks. A bed to do well must have thorough shallow culture, and have all the runners clipped off as soon as they appear.

No particular variety can be recommended which will be the best under all conditions; improvements are being made all the time. It will be best to get the advice of some reliable nurseryman as to the kind to plant for any given locality.

DISEASES OF THE STRAWBERRY.

All of the ills of the strawberry may be directly traced to neglect in one form or another. The most common evil is due simply to starvation. The strawberry plant produces an enormous quantity of fruit on a very small framework, and starvation is very quickly followed by plain signs of impaired vigor or vitality. So general is incomplete fertilizing, that it is common talk that strawberry beds are only profitable the first year. The following comprise the most injurious diseases:

Leaf Blight. This is recognized by the withering of the leaves, usually accompanied by the formation on the leaves of spots, brownish at first but soon becoming dry and whitish with a circle of red, and finally the entire leaf assumes a red-spotted or red discolored appearance. The injury is caused in summer after the fruit is off, by preventing leaf development and thus lessening the power of the plant to make a proper growth of fruit crowns for the next year. It generally affects plants which have made a heavy growth of foliage from a too free supply of available

nitrogen and a lack of potash and phosphoric acid, especially if the new growth is suddenly deprived of free sunshine by a too heavy application of mulch. It seems sometimes due to a weakened vitality by deficient fertilization, but infested plants may communicate the disease to perfectly normal plants.

Infested beds may be moved in the fall and the leaves burned where they lie. Repeat in June, or as soon as the fruit is off, raking up the mulch to aid in the fire. Frequent and thorough spraying with Bordeaux mixture is said to be beneficial. Spray every two weeks beginning just after fruiting, and continue until fall. For the garden, the affected leaves may be raked out by hand, and burned. Clean cultivation, and the destruction of old beds are material aids.

Dieback, or White Bud. The first indication is the appearance in the center of the crown of young leaves of slightly reddish-yellow, or purplish tinge, and an unnatural crinkling of the leaf. The disease soon takes possession of the whole plant, and all its leaves are greatly shrunken. The name "white bud" is sometimes given, from the bleached-out color of the youngest central leaves of the crown.

The remedy is simple: Feed the plants. Kainit seems to be about the most effective single application, and the quickest in its results, but do not apply directly on the plants. The instructions under manuring apply in this case. Probably the best remedy is an application of com-

plete fertilizer, as described earlier in this book. The whole secret is to furnish the plant something to eat as soon as possible.

White Grub. This grub, for whose existence the June bug is responsible, feeds on the roots of strawberry plants and generally begins its attacks in June or July. The leaves of the plants suddenly wilt, and a slight pull brings up the whole plant with but a fringe of its root system attached. The grub is a white or yellowish white worm, from one to one and one-half inches long, with a large chestnut brown head.

The eggs are deposited in untilled ground, especially in pasture fields or hay fields which have been carried over two or more years. The authorities claim that a top-dressing of kainit is beneficial, applied just before a rain. Fall plowing is effective. Do not use sod lands for strawberries until at least two years cultivation occur before fruiting, even planting near a hay field is dangerous. Kerosene emulsion diluted ten times and poured on the surface of the ground around the infested plants will prove beneficial in garden culture. Clean culture is a preventive.

Cut Worm. This is a brownish green-spotted worm, about one inch long. It works chiefly in the early spring by neatly clipping off the roots of tender plants just at the surface of the soil. or slightly below it. It is too well known to farmers generally to require further description here.

As with the "white grub," clean cultivation and the same preventive conditions apply to the cut worm. It is never bad in thoroughly tilled soil, unless near a pasture or hay field. Scatter over the land a week before the plants are set, cabbage leaves or small bundles of green grass which have been steeped in a solution of Paris green. Make the distribution in the early evening. Do not follow a clover sod with strawberries, and you will have no trouble with the cut worm.

Strawberry Weevil. This is a minute beetle; the egg is deposited in the bloom just before it opens, and the stem is partially severed so that it may droop and stop growth in order to furnish food and protection in the young weevil. It may readily be recognized by the drooping immature buds. The attack is made as soon as the bud approaches maturity.

The food is largely the pollen, consequently imperfect (pistillate) plants are not injured. Clean and thorough culture is both remedy and preventive. The destruction of old beds, and all infested beds is necessary. Practice a rotation. In the garden, the plants may be protected by a covering during the blossoming period, of light muslin, or even old newspapers.

Strawberry Thrip. The injury is done to the blossoms, which wilt and die very quickly after the attack. In action this pest is so similar to the weevil that it is sometimes claimed that the two are identical. The thrip is very

small, about one-twenty-fifth of an inch long, and of a yellow color. They eat of the stigmas, and the injury seems to consist largely in preventing the fertilization of the blossom.

Thorough spraying with a strong decoction of tobacco seems to be the only remedy, (one pound of tobacco stems boiled 30 minutes in two gallons of water). The thrip readily moves from one plant to another, so that the whole field must be sprayed, and the dose repeated every three or four days.

Leaf Roller. This is a small greenish caterpillar which operates at the blooming period, by rolling the leaf so that its usefulness to the plant economy is destroyed. It is very easily recognized, and in garden culture the rolled leaves may be picked off by hand and burned.

Use a Paris green spray early in the season, but do not continue it long enough to endanger the contamination of ripe fruit. Mow the infested beds, and burn the leaves as described for "leaf blight."

Crown Miner. This is a small white or pinkish grub, about one-fifth of an inch long. It injures plants by boring into the crowns of young plants. It is common in old strawberry beds. Practice rotation, as insecticides are ineffectual. Care in selecting plants is a precautionary measure, while the best preventive is thorough and frequent tillage. The removal of the mulch as soon as fruiting is over is a preventive measure for many of the evils incident to strawberry culture.

USEFUL TABLES.

AVERAGE COMPOSITION OF POTASH SALTS.

Name of Salts.	Per Cent of Pure Potash. Average
A. Salts containing Chlorides:	
Muriate of Potash	50
Manure Salt	20
Kainit (crude salt)	12.4
B. Salts free of Chlorides:	
Sulphate of Potash	50
Sulphate of Potash-Magnesia	27

COMPOSITION OF FERTILIZER MATERIALS USED AS SOURCES OF PHOSPHORIC ACID.

	Nitrogen. %	Equivalent in Ammonia %	Potash (K_2O) %	Available Phosphoric Acid. %
South Carolina Acid Phosphate	—	—	—	13 to 14½
Florida Acid Phosphate	—	—	—	13 to 16
Tennessee Acid Phosphate	—	—	—	15 to 18
Bone Black, dissolved	—	—	—	16 to 19
Bone Meal	2½ to 4½	3 to 5½	—	6 to 9
Bone, dissolved	2 to 3	2½ to 3½	—	13 to 15
Peruvian Guano	6 to 10	7½ to 12	1½ to 4	7 to 8

COMPOSITION OF FERTILIZER MATERIALS USED AS SOURCES OF NITROGEN.

	Nitrogen. %	Equivalent in Ammonia. %	Potash (K_2O.) %	Phosphoric Acid (P_2O_5) %
Nitrate of Soda	15½ to 16¾	19 to 19¼	—	—
Sulphate of Ammonia	19¾ to 20¾	24 to 25¼	—	—
Dried Blood (high grade)	13 to 14¾	16 to 18	—	2 to 3
Dried Blood (low grade)	10¼ to 11	12½ to 15	—	1½ to 2
Concentrated Tankage	12¼ to 13	15 to 16	—	1 to 2
Tankage	7½ to 9	9 to 11	—	7 to 9
Bone Tankage	5 to 6	6 to 7½	—	9½ to 15
Dried Fish Scrap	9 to 10	11 to 12	—	5½ to 7
Cotton Seed Meal	6½ to 7½	7½ to 9	1½ to 2	2 to 3
Castor Pomace	5 to 6	6 to 7	1 to 1½	1½ to 2
Tobacco Stems	2½ to 3	3 to 3½	2 to 10	½ to 1

AVERAGE COMPOSITION OF THE MOST IMPORTANT FARM MANURES.

	Nitrogen. %	Equivalent in Ammonia. %	Potash (K_2O.) %	Phosphoric Acid (P_2O_5.) %
Cow-Manure (fresh)	0.34	0 41	0.40	0.16
Horse-Manure (fresh)	0.58	0.70	0 53	0.28
Sheep-Manure (fresh)	0.83	1.00	0.67	0.23
Hog-Manure (fresh)	0.45	0.54	0.60	0 19
Hen-Dung (fresh)	1.63	1.98	0 85	1.54
Mixed Stable-Manure	0.50	0.60	0 63	0.26

TABLE GIVING THE AMOUNTS OF FERTILIZER INGREDIENTS

(POTASH, PHOSPHORIC ACID AND NITROGEN.)

CONTAINED IN THE CROP FROM ONE ACRE.

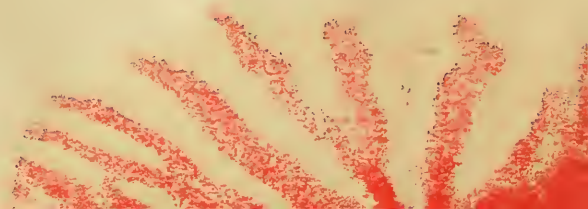
Crop.	Yield.	Straw, etc.	Potash.	Phosphoric Acid.	Nitrogen.
Apples	15 tons	——	60 lbs.	30 lbs.	39 lbs.
Barley	30 bu.	2000 lbs.	51 "	17 "	57 "
Beans	30 "	2700 "	53 "	30 "	75 "
Buckwheat	34 "	2800 "	40 "	14 "	56 "
Cabbage	30 tons	——	270 "	70 "	200 "
Clover, green *	——	15 tons	140 "	40 "	130 "
Clover, dry	——	2 "	88 "	18 "	82 "
Corn	70 bu.	6000 lbs.	55 "	48 "	83 "
Grapes	2 tons	7000 "	39 "	11 "	32 "
Hops	600 lbs.	2700 "	53 "	23 "	84 "
Mixed Hay	——	5000 "	77 "	18 "	70 "
Oats	60 bu.	3200 "	62 "	22 "	55 "
Onions	45,000 lbs	——	72 "	37 "	72 "
Pears	16 tons	——	26 "	10 "	32 "
Peas	30 bu.	3000 lbs.	52 "	33 "	108 "
Plums	8 tons	——	40 "	4 "	30 "
Potatoes	200 bu.	1500 lbs.	74 "	21 "	46 "
Rye	30 "	4250 "	45 "	26 "	51 "
Sugar Beets	15 tons	6000 "	143 "	32 "	69 "
Timothy Hay	——	4000 "	94 "	23 "	89 "
Tobacco	1600 lbs.	1400 "	200 "	16 "	76 "
Tomatoes	10 tons	——	54 "	20 "	32 "
Turnips	700 bu.	5 tons	180 "	52 "	80 "
Wheat	35 "	3000 lbs.	31 "	24 "	59 "

* Crimson Clover.

USUAL DISTANCES FOR PLANTING FRUIT TREES AND VINES.

(In planting trees the greater distance should be given on the richer soils.)

Apples	20 to 30 feet each way.
Pears (Standard)	20 " 25 " " "
Pears (Dwarf)	12 " 15 " " "
Quinces	15 " " "
Peaches	18 " 24 " " "
Plums	15 " 20 " " "
Cherries	15 " 20 " " "
Figs	12 " 15 " " "
Japan Persimmons	15 " 20 " " "
Mulberries	20 " 25 " " "
Oranges (Sweet)	20 " 25 " " "
Oranges (Japanese)	12 " 15 " " "
Blackberries	6 by 4
Raspberries	6 " 3
Currants	5 " 3
Gooseberries	5 " 3
Strawberries (Hills)	36 x 18 inches.
Strawberries (Matted rows)	48 x 12 "
Grapes	8 x 8 to 10 x 12 feet



SUGAR BEET CULTURE

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PUBLISHED BY

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Sugar Beet Culture

A half century of failure had well nigh convinced the American farmer that the production of sugar from the beet would not succeed here when on the site of one of the most disastrous failures there arose the first successful American Beet Sugar Factory. This was established at Alvarado, California, in 1880, and since that time we have learned that the early failures were due to selection of unsuitable locations in relation to soil, climate, water supply and labor conditions, as well as to bad business management and defective equipment.

So rapid has been the progress of the beet industry in the United States that it now produces about one-fourteenth of the world's beet sugar supply, or one-twenty-eighth of the world's total sugar supply.

In the campaign of 1908-9 there were operated 63 factories, slicing nearly 4,000,000 tons of beets and producing about 500,000 tons of sugar. These factories were located in 16 states, those having more than one factory being California 8, Colorado 16, Idaho 4, Michigan 16, Utah 5, Wisconsin 4, while Illinois, Iowa, Kansas, Minnesota, Montana, Nebraska, New York, Ohio, Oregon, Washington and Arizona have one each, the factory in the last named not being in operation.

On the average about one long ton of sugar is produced per acre.

The factories in operation have a daily slicing capacity of 49,200 tons and those under construction, or, not in operation have an additional capacity of 3,200 tons. The individual factories can slice from 350 to 3,000 tons per day. The two most common capacities are 1,200 and 600 tons. Many of the smaller factories are constructed so as to permit of doubling their capacity at a relatively small cost.

The factories may be roughly arranged in three groups—those of California, of Colorado and neighboring states where irrigation is used, and those of the humid region, of which Michigan and Wisconsin are the most important.

Climatic Conditions

Volumes have been written in regard to the climate, soil, cultural and manufacturing conditions best suited to the industry. While it is true that most of the early failures were due to neglect of these conditions, it is also true that there are a number of local conditions that have had much influence in fixing the three present centers of the industry in the United States.

In general the successful factories here, as well as abroad, are located within 100 miles on either side of a line whose average summer temperature is 70 degrees Fahrenheit.

The distribution of the rainfall in the humid region is also important, a low rainfall in October and November being desirable to permit the ripening and harvest of the beets.

Soils

It has often been stated that any soil that would raise corn would produce beets, but it would be nearer the truth to say that any soil that will raise beets will also produce corn; for there is much corn land that is quite unsuited for beets.

In general, a moderately productive, sandy loam is preferred for beets. But about the factories in the humid section beets will be found growing on every kind of soil from sandy to clay loam, and some good beets have even been grown on muck. On the lighter soils the cost of production, per acre, is less than on the heavier types.

Cultural Methods

Local conditions enter very largely into the preparation of the soil, the distance of planting, and the tillage of the crop. Since the factories usually specify the essentials in their contracts and have field superintendents to advise growers it is no unusual thing to find fields near together, but under contract to different factories, handled in quite different ways. Hence, it is not necessary to go into details upon these matters.

Varieties

Since the factories furnish the seed, the variety is not left to the discretion of the grower, but the factory manager or field superintendent furnishes seed of varieties which seem best suited to the soil conditions of the different fields under contract.

Seed Production

The production of beet seed is a business by itself and is rarely carried on by farmers who raise beets for factory purposes. The experiments on the production of seed in the United States seem to show that seed of good quality can be produced here. But at present most of the seed is imported and, perhaps, the price of seed is not high enough to encourage the outlay required for the proper equipment for producing high grade seed here. The imported seed comes mainly from Germany, smaller quantities being brought from France, Holland and Austria.

Cost of Production

When we recall the very great range in the estimates of the cost of producing a bushel of our most common crops, such as wheat or corn, it is not strange that there should be wide differences in the ideas of farmers as to the cost of producing an acre of a comparatively unknown crop like beets. And soil conditions, labor rates, and familiarity with the work do make a great difference in the cost.

As an offset to this the farmer knows in advance the price he is to secure for his crop and generally has a choice between a flat rate per ton, usually $4.50 or $5.00, and a rate of $4.00 or $4.50 per ton for beets containing 12 per cent of sugar with 33 1/3 cents for each additional per cent. As beets often run over 18 per cent sugar, there is a chance to make a substantial profit by adopting the latter form of contract, and the factories, of course, encourage the raising of

the highest grade beets since it reduces the manufacturing cost. As a rule, however, the beets with the highest sugar content do not produce the largest yield per acre. Hence, much study is given by seed growers to the matter of producing beets that will combine a high sugar content with a good tonnage per acre. Seed which will give good yields of high quality beets under proper conditions may prove disappointing under bad conditions of soil, tillage, season, or manuring.

While the factories instruct the farmers in regard to suitable soils and tillage, even to the extent of sometimes taking charge of all the tillage work from the time the beets are planted until the harvest, there has been too little attention paid to the matter of profitable manuring of the crop. Doubtless this is due in some degree to the opinion commonly held in the irrigated region that water is both food and drink to the plant, while in the humid region most of the beets are grown where the use of commercial plant foods is very little understood.

Under these circumstances, it is not strange that very few factory managers or superintendents have given any serious attention to the question of the most profitable manuring of the crop. Too often it is dismissed as being "unnecessary" instead of inquiring whether it can be made profitable. From time to time, some experiments have been made but often these took the form of testing some manufacturer's "brand" rather than an investigation of the real plant food requirements of the crop. And even when more systematic experiments were undertaken, the time and method of applica-

tion and the proportions used were not such as to give promise of results of practical commercial value to the beet grower.

What the Crop Takes from the Soil

The average yield of beets, per acre, in the United States is between 9 and 10 tons. In the irrigated region yields are, of course, better controlled. In the humid region the yield may range from 5 to 20 tons per acre according to the season and soil.

Ten tons of beets with their tops take from the soil

95 pounds of Potash
22 pounds of Phosphoric Acid
46 pounds of Nitrogen.

The proportions of these present in the roots and in the tops vary with the variety of beet, the season, the ripeness of the roots, and the character of the soil. For average conditions, there would be hauled away in the ten tons of roots

66 pounds of Potash
16 pounds of Phosphoric Acid
32 pounds of Nitrogen,

while that in the tops would remain on the farm.

Farmers' Bulletin 52, United States Department of Agriculture, says: "As to the relation which the quantity of material returned to the soil should bear to the quantity abstracted by the beet, it may be said in general that it is desirable to return as much nitrogen, from one and one quarter to one and a half times as much potash, and two and a half

times as much phosphoric acid as have been removed by the roots. Greater additions of potash and phosphoric acid have no disadvantageous effect on the roots."

On this basis we should supply for each ten tons of roots removed

200 pounds Sulphate of Potash

300 pounds Acid Phosphate

200 pounds Nitrate of Soda (or 250 pounds blood).

On clover sod or on land where a heavy application of manure has been applied the previous year the nitrate or blood may be reduced to one half.

We must remember that the beet is a highly bred plant and as such requires corresponding care in feeding. To obtain the best results it must be supplied

with the right plant foods,
in the right amounts,
in the right form,
in the right way,
at the right time.

What the plant foods are, we already know, and the relative amounts needed have been shown. Since it is important that the beet should make a continuous growth, the plant foods should be in such forms that the beet can use them as needed. This means that they must be soluble or in such loose combination with the soil that the roots can readily take them up. A large amount of unavailable plant food in a soil is of no advantage to the beet and any attempt to increase its availability by turning under green crops or apply-

ing heaving dressings of barnyard manure the same season that the beets are raised, will result in a crop of low sugar content.

On most beet soils both potash and phosphoric acid compounds can be profitably used, and on many, nitrogen compounds are also profitable, but must be used with discretion.

The beets themselves have means of letting us know whether they are hungry for certain plant foods, and if we will carefully examine the fields through the growing season we may get some very valuable hints in regard to what is needed to so supplement the soil supply as to make a properly balanced ration for maximum sugar production.

If the leaves turn yellow before maturity, a lack of nitrogen is shown.

If phosphoric acid is deficient, the leaves do not assume the usual lighter shade at maturity, but wither while still retaining their dark green color, and reddish colored spots on the edges of the leaves are sometimes seen although these are not very conspicuous. In case of both nitrogen and phosphoric acid hunger, the size of the leaves is much reduced in the early stages of growth.

When there is a lack of available potash, the leaf growth may be quite strong up to the time that cultivation ceases and the color may be rich dark green. But development is checked rather suddenly at a time when the roots should increase rapidly in size. The leaves do not ripen normally, but bear yellow spots, which later become brown. The leaves are inclined to curl and wither quickly in the sunshine.

Experiment by Mr. S. Godbold, Charlevoix, Mich.
Right, no fertilizer, yield 7 tons; test 15.8 per cent.
Left fertilized with 500 lbs. per acre of complete fertilizer containing 10 per cent potash, yield 10 tons; test 16 per cent.

EXPERIMENTER	Acre No.	Fertilizer used—pounds per acre			Yield net pounds per acre	Increase in pounds over unfertiliz'd	Sugar in Beet % (test)	Value of Increase $	Cost of Fertilizer $	Profit from Fertilizer $	$1 spent for Potash returned $
		Sulphate of Potash	Acid Phosphate	Blood							
Louis Kain,	1	.....	.....	.....	26,240	.....	14.7	.....	.....	.....	.....
Owendale, Mich.	2	40	100	32	37,200	10,960	17.9	49.49	3.00	46.49	39.42
Clay Soil.	3	.....	100	32	27,760	1,520	16.	10.07	2.00	8.07	.....
Wm. Emory,	1	.....	.....	.....	6,400	.....	16.5	.....	.....	.....	.....
Caro, Mich.	2	50	125	40	13,140	6,740	16.3	19.76	3.75	16.01	7.22
Sandy Loam.	3	.....	125	40	10,320	3,920	15.9	10.73	2.50	8.23	.....
Fred Hutchinson,	1	.....	.....	.....	28,000	.....	14.0	.....	.....	.....	.....
Owendale, Mich.	2	80	200	64	36,000	8,000	17.8	43.36	6.00	37.36	10.67
Clay Loam.	3	.....	200	64	32,000	4,000	16.2	22.02	4.00	18.02	.....
Saggers Bros.,	1	.....	.....	.....	24,560	.....	16.1	.....	.....	.....	.....
Holland, Mich.	2	66	165	53	27,600	3,040	17.3	14.45	5.00	9.45	15.26
Clay Loam.	3	.....	165	53	26,000	1,440	12.6	—10.98*	3.34	Loss	.....
August Wearsiky,	1	.....	.....	.....	14,160	.....	16.5	.....	.....	.....	.....
Sebewaing, Mich.	2	40	100	32	20,820	6,660	17.1	22.06	3.00	19.06	22.16
Clay Loam,	3	.....	100	32	14,540	380	16.	— .10*	2.00	Loss	.....
E. H. Hume,	1	.....	.....	.....	31,240	.....	13.4	.....	.....	.....	.....
Lansing, Mich.	2	100	250	80	30,500	Loss	15.	6.25	7.50	Loss	3.55
Clay Loam.	3	.....	250	80	30,800	Loss	13.1	— 2.63*	5.00	Loss	.....
C. A. Taggett,	1	.....	.....	.....	16,000	.....	15.2	.....	.....	.....	.....
Caro, Mich.	2	100	250	80	22,000	6,000	15.2	16.71	7.50	9.21	2.51
Clay Loam.	3	.....	250	80	20,000	4,000	15.	10.44	5.00	5.44	.....
A. Beattie,	1	.....	.....	.....	14,920	.....	15.	.....	.....	.....	.....
Charlevoix, Mich.	2	100	250	80	21,400	6,480	15.	17.82	7.50	10.32	4.14
Clay Loam,	3	.....	250	80	17,320	2,400	15.3	7.47	5.00	2.47	.....
E. Graham,	1	.....	.....	.....	14,200	.....	16.2	.....	.....	.....	.....
Charlevoix, Mich.	2	100	250	80	17,040	2,840	17.5	12.04	7.50	4.54	2.78
Clay Loam.	3	.....	250	80	15,840	1,640	16.3	5.08	5.00	.08	.....
Wm. Shapton,,	1	.....	.....	.....	14,400	.....	15.1	.....	.....	.....	.....
Charlevoix, Mich.	2	90	225	72	18,000	3,600	15.4	10.85	6.75	4.10	2.54
Clay Loam,	3	.....	225	72	16,344	1,656	15.	5.13	4.50	.63	.....
S. Godbold,	1	.....	.....	.....	13,960	.....	15.8	.....	.....	.....	.....
Charlevoix, Mich.	2	100	250	80	20,200	6,240	16.	18.60	7.50	11.10	4.57
Sandy Loam.	3	.....	250	80	17,480	3,520	14.8	7.18	5.00	2.18	.....
Chas. W. Hess,	1	.....	.....	.....	18,524	.....	15.1	.....	.....	.....	.....
Sebewaing, Mich.	2	100	250	80	20,632	2,108	17.4	13.77	7.50	6.27	1.45
Clay Loam.	3	.....	250	80	19,796	1,272	17.1	10.15	5.00	5.15	.....

*Loss.

EXPERIMENT BY WM. EMORY, CARO, MICHIGAN

No Fertilizer.

Fertilized with 250 lbs. per acre of Complete fertilizer containing 10 per cent of potash.

Fertilized with Nitrogen and Phosphoric Acid.

If the deficiency of potash is very marked, the leaves become narrow and the plants are especially susceptible to the bacterial disease which manifests itself by curiously crumpled, small leaves and by dark rings in the root. This disease is quite common in American beet fields. But since most of the diseased beets have lost their tops before harvest, it is frequently overlooked. A diseased beet, which still retains its top, seldom contains over 10 per cent of sugar.

Sources of the Plant Food

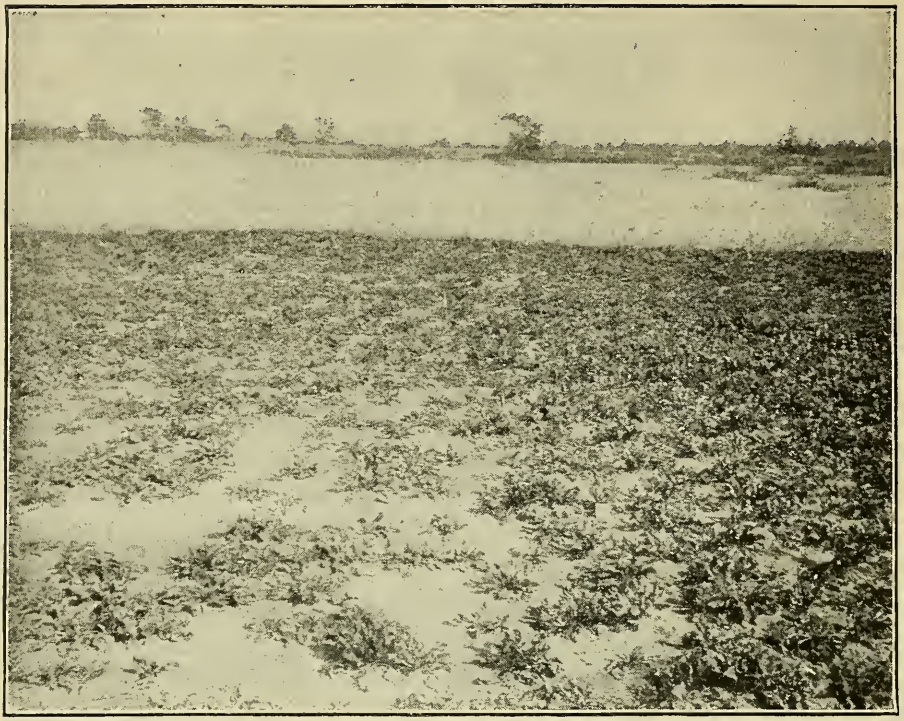
If barnyard manure is to be used to supply nitrogen to the beet, experience has shown that it should be applied from six months to a year before the beets are planted.

Where manure, or, green crops are plowed under at the time the beets are planted, there is an excessive growth of leaf and the beets are so late in maturing that the sugar content is seriously reduced.

On the other hand, if nitrate of soda is used it may be applied after the beets are growing, provided the quantity be not too great.

As a source of phosphoric acid, acid phosphate, dissolved bone black, and acidulated bone are suitable and basic slag is good where it can be obtained. The excess of lime in the slag may be of benefit on some soils, for the beet contains considerable lime. If bone is used it should be as finely ground as possible, but it acts rather too slowly.

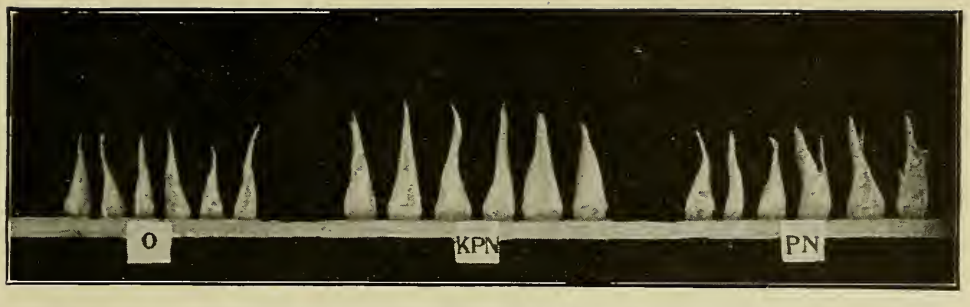
Not only is potash the most abundant plant food in the beet, but it has a special work to perform in connection with



Field of Wm. Emory. Complete fertilizer with 10 per cent potash on right. On left no fertilizer, with bad stand and unprofitable yield.

the formation of the substance that gives the root its value—the sugar. During the last four weeks of growth the beet must not only increase in size but must manufacture and store a large amount of sugar. To do this successfully there must be present, in available form, enough potash for both leaves and root.

If crude salts, like Kainit, are used, it is, perhaps, better to apply them the previous fall. But as the refined salts are mostly used for beet culture, they may be used at, or just before, planting time.



Potash (K) improves the size, yield, shape and sugar content.

The sulphate of potash is generally used in sugar beet mixtures.

On land which has been cropped for a long time without any application of potash salts, it occasionally happens that a moderate application of potash salts seems to produce no increase in the yield of beets while a much heavier application is quite effective. The explanation of this seems to be that the beet is not a vigorous forager for potash and that the soil hunger for the potash is such that it fixes a certain amount too firmly for the beet to get it, but when this amount is exceeded the remainder is available to the beet. Hence, the importance of using a liberal amount of potash for the first application, and of maintaining a suitable reserve in the soil.

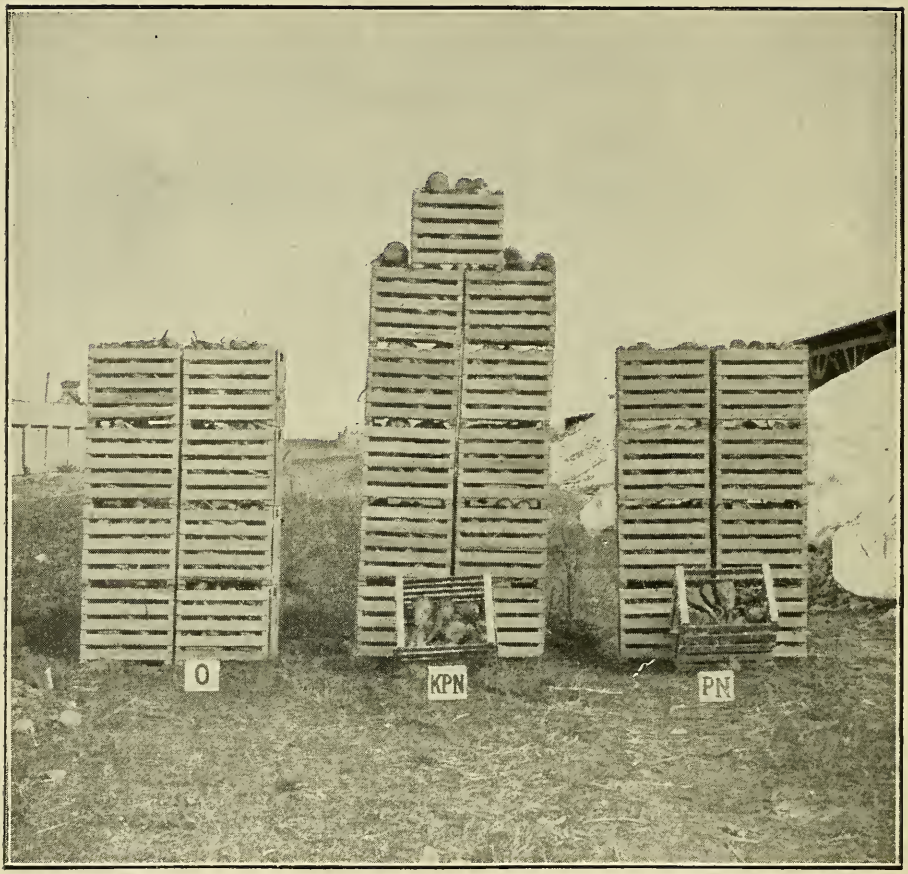
Amounts to Use

Most of the plant food used in America is in the form of ready mixed fertilizers. For beet culture a suitable formula for typical loam or sandy loam soils is

Nitrogen	2 per cent
Available Phosphoric Acid	7 per cent
Potash	10 per cent

Of this, from 500 to 1,500 pounds per acre may be used.

Experiment by Louis Kain, Owendale, Mich.



O. No fertilizer, yield 13.2 tons; test 14.7 per cent.

KPN. Complete fertilizer with 10 per cent potash, 200 pounds per acre, yield 18.6 tons test 17.9 per cent.

PN. Fertilized with Nitrogen and Phosphoric Acid but no potash; 16.9 tons; test 16.0 per cent.

The crates contain the yield from 2½ square rods of each plat. In this experiment one dollar spent for potash returned thirty-nine dollars and forty-two cents.

The actual plant food in a ton of this goods would be obtained by mixing 1,000 pounds of 14 per cent acid phosphate, 400 pounds sulphate of potash, and 300 pounds of dried blood. Instead of blood, 200 pounds of sulphate of am-

monia may be used to furnish the nitrogen, or 275 pounds of nitrate of soda. If nitrate of soda is used the mixture must be distributed as soon as made, or the nitrate may be held out and applied later. One may easily increase the potash in mixed goods of too low grade. To increase the potash one per cent add two pounds of sulphate (or muriate) of potash in each one hundred pounds of the fertilizer. Thus to bring goods with only five per cent of potash up to ten per cent, add ten pounds of sulphate of potash to each ninety pounds of the fertilizer.

Method of Application

If the seeders have a fertilizer attachment, 100 to 200 pounds, per acre, may be drilled in with the seed and the remainder may be applied broadcast before harrowing. There is no danger that any of the ingredients, except nitrate of soda, will be lost by leaching so the broadcast application may be made as soon as the land is plowed, and if fall plowing is used it would be quite safe to apply the potash salts and the phosphate at that time.

Beet seed is often sown with an ordinary grain drill, only every third delivery tube being left open for the seed. In such cases the fertilizer may be applied at the same time by using a grain drill with the usual fertilizer attachment. All the delivery tubes in the fertilizer attachment are left open, thus practically combining drilling in the row with broadcasting, a method that finds much favor where it is desired to force the young beet plants ahead of the weeds and at the same time provide a wider distribution of the plant food at the time the sugar is forming most rapidly.

Any excess of mineral fertilizer not used by the beet crop will be available for the following crops. The marked increase in the yield of grain that followed the introduction of the sugar beet industry in Europe was due quite as much to the heavy fertilization as to the improved tillage.

Plant foods are used in beet culture to increase the yield, to improve the sugar content, to secure a full stand, and to make the beet outgrow the weeds and permit earlier thinning. For these purposes the fertilizer must be properly balanced for the crop, and the previous treatment as well as the composition of the soil must be taken into consideration.

American farmers when first experimenting with fertilizers are quite apt to begin with bone because it is a familiar material and readily obtained. It contains nitrogen and phosphoric acid but *no potash.*

Facts from Field Tests

Some experiments conducted in Michigan in 1907 and 1908 may illustrate the profits of a properly balanced fertilizer on the beet crop.

The plan was the simplest and plainest possible; on one acre no fertilizer was used, on the second 500 pounds of a complete fertilizer containing 2 per cent of nitrogen, 7 per cent phosphoric acid and 10 per cent potash, while on the third acre 500 pounds of a fertilizer with 2 per cent nitrogen, 7 per cent phosphoric acid, but no potash, were used.

By comparing acre one with acre two we learned whether a complete fertilizer would be profitable, and by compar-

ing acre two with acre three the effect of the potash could be learned. See table, page 12.

The experimenters used the fertilizer at the rate of from 200 to 500 pounds per acre. The seasons at most points were unfavorable, the drought during August not permitting a continuous growth or the plant food to be used to the best advantage. On this account the lighter applications of fertilizer may have made a relatively better showing than the heavier ones.

The profits are calculated on the basis of $4.50 for 12 per cent beets and 33 1/3 cents for each additional per cent of sugar in the beet.

The profits are certainly enough to justify the continued use of fertilizers and the *improvement* in both *yield* and *sugar content* due to the potash is *very striking and shows excellent profits.*

In the case of Mr. Hume's experiment a slight loss in yield was more than compensated by the increase in sugar on the plat with the potash fertilizer, while a loss of $2.79 on plat 3 fertilized only with nitrogen and phosphoric acid was converted into a gain of $6.24 by adding the potash.

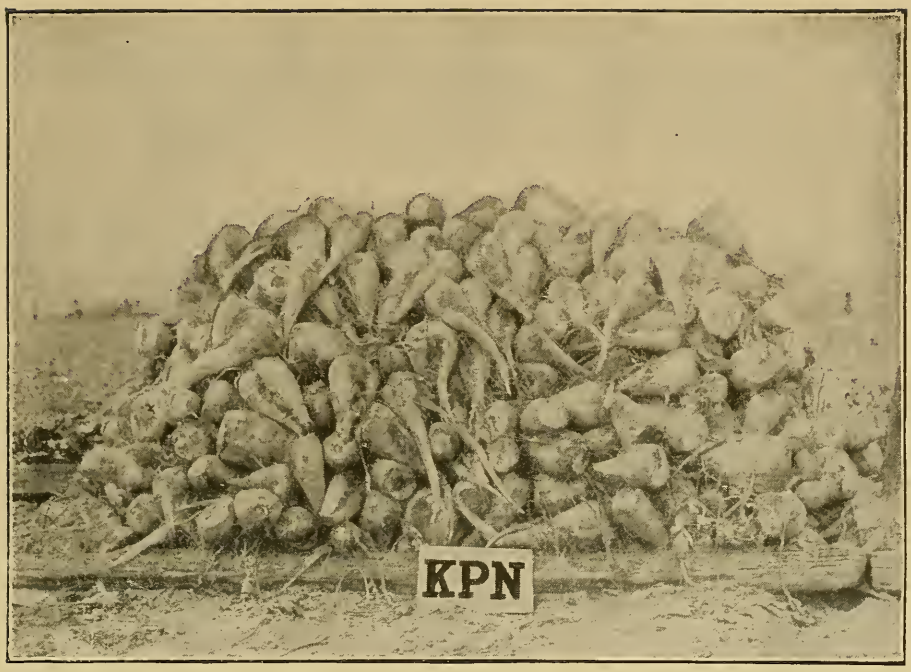
Throughout all the experiments, the use of potash has the effect of increasing the profits out of all proportion to its cost, and the use of a fertilizer containing 10 per cent of potash is fully justified.

The Michigan Experiment Station has conducted many systematic sugar beet experiments with fertilizers and barn yard manure and sums up the results by a statement that no single element or two element fertilizer is as profitable as a

Experiment by A. Beattie, Charlevoix, Mich. Fertilized with Nitrogen and Phosphoric Acid. (See page 12.)

complete fertilizer for beets and that the proper commercial fertilizer is better than barnyard manure, because the manure while producing in some cases somewhat better yields always produced beets of such low sugar content and purity as to make the amount of sugar per acre, and the money secured from the crop, less with the manure than with the fertilizer. In these experiments the equivalent of 500 pounds of 4-7-9 goods was compared with 20 loads of manure, the manure containing over 5 times as much plant food as the fertilizer.

The Wisconsin Experiment Station in summing up the results of fertilizer tests states—Rpt.—1905—"It will be noted that there was a marked improvement both in the yield and



Experiment by A. Beattie, Charlevoix, Mich. Fertilized with Complete fertilizer containing 10 per cent potash. (See page 12.)

the quality of the beets grown on the fertilized half of the field as compared with the results for either of the plats which received no fertilizer, the average sugar content of the beets on the unfertilized plats being 16.9 per cent and on the fertilized plats 17.3 per cent; the average purity on the unfertilized plats being 89.1 and on the fertilized plat 90.2. Through the application of fertilizers the yield of beets was increased by 41.9 per cent and the yield of sugar per acre was increased by 47.3 per cent over the corresponding figures of the unfertilized plats."

The New York (Geneva) Experiment Station, Rpt. 1898, shows that from 500 to 1,500 pounds per acre of complete

commercial fertilizer are profitable on sugar beets but that twenty tons of barnyard manure did not increase the crop enough to pay for the cost of hauling and distribution.

Potash Not Injurious to the Quality of the Beet for Sugar Making

It is sometimes claimed that potash salts impair the purity of the beet juices and, hence, tend to interfere with the separation of the sugar in the factory.

If proper amounts of potash salts of high grade are used at the right time there need be no fear from this source. Very large applications of crude potash salts at planting time might have this effect; but any soluble salts used at that time would have the same effect. As mentioned above, if crude salts, like Kainit, are used on beet fields it is better to apply them some months in advance of planting.

The continued use for 15 years of considerable quantities, from 100 to 200 pounds, per acre, each year at the time of planting, of even muriate of potash in addition to acid phosphate and sulphate of ammonia was shown by the Indiana Experiment Station to produce beets of higher purity, better form and greater yield than were produced on the plats fertilized with barnyard manure or on those receiving no fertilizer.

If the right plant foods are used at the right time, in the right proportions, there need be no fear that the increased yield will be at the expense of sugar making value.

H. A. Huston.

ADDRESS LETTERS, NOT TO INDIVIDUALS, BUT TO GERMAN KALI WORKS.

OFFICE OF

GERMAN KALI WORKS,

93-99 NASSAU ST.
BENNETT BUILDING.
ROOMS 707 & 708.

New York, March 1, 1911.

Mr. Chas. R. Green,

Amherst, Mass.

Dear Sir:

Replying to your favor of the 28th ult. will say that it gives us pleasure to send you by separate mail, a copy of each of the publications requested with the exception of the booklet "Farmers Guide" which is at present out of print. We are also sending you some booklets which you may not have in your files, including some which have been issued by our foreign offices. Trusting that these will be of interest, we are,

Yours very truly,

GERMAN KALI WORKS.

Fert. O. & G.
A.F.
R.
O.C.
P.P.
S.B.C.
St.C.
F.T.
E.w.F

commercial fertilizer are profitable on sugar beets but that